COMMUNICATION SYSTEM WITH A BEAMFORMED CONTROL CHANNEL AND METHOD OF SYSTEM CONTROL

BACKGROUND OF THE INVENTION

This invention relates, in general, to a communication system with a beamformed control channel and particularly to a method of system control in a communication system having an adaptive antenna array.

SUMMARY OF THE PRIOR ART

Cellular communication systems, generally, are comprised of many adjacent "cells" each administered by a base station controller. Usually, each base station controller will control a number of base transceiver stations responsible for administering individual sectors within each cell. Mobile units affiliated to a particular system (which could be a time or frequency division system) are free to move between cells and are in controlled communication with, principally, only one base transceiver station at any one instance in time, and each mobile unit is thus subject to a hand-off mechanism between base transceiver stations (and occasionally base station controllers) in adjacent sectors (or cells, respectively) when the mobile unit transitions a nominal boundary between adjacent sectors or cells. Typically, this nominal boundary is predefined in terms of either an acceptable level for received signal strength or a point in time when a bit error rate (BER) for the communication becomes unacceptable.

In terms of system administration and particularly the control of mobile units, for example, each base station controller continuously transits an omni-directional broadcast control channel (termed a BCCH) at full transmit power, which BCCH supports control data for the mobile units. For example, the BCCH is encoded with channel information that instructs a selectively identified mobile unit to utilise a particular channel frequency (and sometimes a particular channel timeslot) for a communication. Additionally, nearest neighbour BCCHs covering adjacent sectors or cells are typically monitored by the mobile units in a serving coverage area to determine whether a handoff is necessary (because, for example, a signal strength of a BCCH of a serving cell is significantly inferior to a signal strength of a BCCH of an adjacent cell). Usually, mobile units request, for example, a service by using a dedicated Random Access Control Channel (RACH) on an assigned return (up-link) BCCH channel resource, typically time-slot zero in a time division multiplexed (TDM) system such as the Global System for Mobile (GSM) communication. Furthermore, all mobile units in a particular coverage area have access to this RACH all the time, and so contentions may arise in the event that two mobiles simultaneously attempt to transmit on the RACH. Specifically, a base station controller (or a base transceiver station) is unable to resolve these simultaneous transmissions, and is therefore unable to isolate and is hence unable to attend to a specific request from a particular mobile. Consequently, a handshake with either of the mobile units is not initiated by the base station controller (or the base transceiver station) within a predetermined time, and both mobile units default and temporarily abort their respective access attempts. Then, after differing pseudo-random delays, each mobile unit again attempts to establish contact with the base station controller (or the base transceiver station), with the pseudo-random delay providing a mechanism for resolving the mobile units by dispersing in tame individual RACH access attempts. As will be understood,

the message transmitted by each mobile unit on the RACH may take the form of a randomly generated data word (having a length of, say, 8 bits), while the base station controller (or the base transceiver station) may identify the corresponding mobile unit by simply re-transmitting this data word.

The present requirement that systems exhibit a constant BCCH currently inhibits the use of adaptive beamforming techniques, and hence maintains the requirement for careful BCCH re-use planning to prevent detrimental levels of interference occurring between control channels. Therefore, downlink beamforming from an adaptive array of antenna elements co-located with each base site controller is currently restricted to systems that physically, differentiate traffic channels (TCHs) and BCCH frequencies and functions. Indeed, since beamforming is currently limited to TCHs, communication systems are not frequency optimised.

SUMMARY OF THE INVENTION

In a first aspect of the present invention there is provided a method of establishing radio communication between a communication unit and a base station having an array of antenna elements, the method comprising the steps of: a) at the communication unit, sending a system access request on a dedicated wide area control channel; b) at the base station, receiving the system access request and, in response thereto, forming a first narrowbeam control channel to the communication unit and transmitting system control information to the communication unit on the first narrowbeam control channel, the system control information transmitted from the array of antenna elements and arranged to identify a narrowbeam communication resource for use in the radio communication; and c) at the communication unit, receiving the system control information and configuring the communication unit to utilise the narrowbeam communication resource for the radio communication

In a preferred method, the present invention further includes the steps of: a) receiving the system access request at a plurality of base station; b) at each base station, making signal parameter measurements of the access request to determine a rank order of signal parameter measurements with respect to the plurality of base stations; and c) selecting a base station to serve the communication device from the rank order.

Preferably, the method of the present invention further comprises the steps of: at the communication unit: a) measuring a signal parameter for the first narrowbeam control channel to produce a signal parameter measurement; b) determine whether the signal parameter measurement is above a predetermined threshold deemed sufficient to support the radio communication; and c) when the signal parameter measurement is below the predetermined threshold, transmitting a system configuration request on a second narrowbeam control channel to request re-orientation of the first narrowbeam control channel with respect to the communication unit.

The method of claim of the present invention may also include the steps of: at the communication unit: a) measuring a signal parameter for the first narrowbeam control channel to produce a signal parameter measurement; b) determining whether the signal parameter measurement is above a predetermined threshold deemed sufficient to support the radio communication; and c) when the signal parameter measurement is below the predetermined threshold, transmitting a system configuration request on a second narrowbeam control channel to request assignment